Bulletin 452 April, 1942

ANNUAL REPORT

for the

Year Ending October 31, 1941

Connecticut
Agricultural Experiment Station
New Haven

LETTER OF TRANSMITTAL

January 15, 1942

To His Excellency
Robert A. Hurley,
Governor of Connecticut

Sir:

We have the honor to submit herewith the Annual Report of The Connecticut Agricultural Experiment Station for the Station year ended October 31, 1941. This is a brief statement in two parts:

1. A Report of Progress, which is in the form of the Report of the Director to the Board.
2. The Report of the Station Treasurer for the fiscal year ended June 30, 1941.

Respectfully yours,

CONNECTICUT AGRICULTURAL EXPERIMENT STATION
THE BOARD OF CONTROL
E. C. Schneider, *Secretary.*

REPORT OF THE DIRECTOR

FOR THE

YEAR ENDING OCTOBER 31, 1941

To the Board of Control of the
Connecticut Agricultural Experiment Station:

As THIS Station year comes to a close the world is shaken by conflicts of arms, of trade and of social philosophies. As a nation, we are preparing for war on a gigantic scale. Farmers, on their part, must increase production in the face of declining supplies of labor, fertilizers, spray materials and many other items.

As the scientific servant of agriculture, how can the Station be of the greatest use? It seems clear that we should bend every effort, (1) to place in the hands of farmers the latest information that bears on efficient production, and on economy in the use of materials; (2) to find substitutes for materials that are short, ways to save spray materials and fertilizers, higher yielding varieties of crops; and (3) to maintain without serious interruption its fundamental research, upon which all future progress depends.

THE STATION YEAR

The year has been a satisfactory one in many respects. It has seen the completion of our new greenhouses and the service and laboratory building at New Haven, and of the new laboratory at the Tobacco Substation. Several researches have been successfully completed and real progress recorded on many others. All are briefly noted in the pages that follow.

The annual Field Day at Mount Carmel Farm was one of the best ever held. More than 1,000 visitors were checked through the gate. E. G. Woodward, Dean of the State Agricultural College was the guest speaker.

Katherine Palmer Plumb, who has so ably filled the post of Editor since 1934, resigned on October 31. Alice L. Dustan of *The New York Times* was appointed in her stead.

Henry Kiley retired on September 30, after 46 years of loyal service as gardener.

Ruth Hendrickson came to the Station in December, 1940, as Assistant Librarian.

Geraldine Everett and Eleanor DeWolf resigned secretarial posts. They were succeeded by Jane Andrew and Mary Kinnane.

Military leaves were granted to Captain O. B. Cooke and R. T. Hall of the Gypsy Moth unit. Both were members of the Connecticut National Guard which was called in March, 1941.

Dr. W. R. Singleton was granted leave of absence during the fall to substitute for Dr. H. K. Hayes at the University of Minnesota.

Dr. C. I. Bliss has continued to act as Consulting Biometrician, spending part time at the Station.

The Station suffered a great loss in the death of V. L. Churchill, our Sampling Agent. The esteem in which he was held is well expressed in the following minute adopted by the staff:

VIRGIL L. CHURCHILL

Virgil L. Churchill, a valued member of the Station staff for 46 years, died on March 22, 1941, after a brief illness of two days.

Mr. Churchill entered the employ of the Station while Professor Johnson was its Director and when its staff comprised hardly more than a dozen people. He was a willing and conscientious worker and the type of man to whom tasks could be assigned and then forgotten in the assurance that they would be well and faithfully done. So it was that over the years he acquired and performed a multitude of services essential to the routine of Station life and work. His chief duty was that of official sampling agent of the Station, having been given that assignment in 1897. In that capacity he was well known to farmers and to manufacturers and dealers of the fertilizer and feed industries on whom he called regularly to collect samples of fertilizer and feeding stuffs for analysis by the Station. He knew the importance of this feature of inspection service, and the purchaser, the trade and the laboratory alike trusted his work.

Cheerfulness was his habit and rarely did anyone catch a hint of any personal cares or anxieties that were his. He had a bluntness of speech and manner at times, but the genuine kindliness behind it was so plainly apparent that it caused no hurt and left no scars. His activity and enthusiasm belied his years; few men ten years his junior could stand the pace of his working day.

A plain, dependable and good man, Mr. Churchill lived the precepts of the faith he professed and honored his work in the doing of it. He won the friendliness of all, and the affection of those who knew him best. It is a tribute to him as a man and as a public servant that he will be missed by so many—and remembered so long.

Progress of the Station's Work

ANALYTICAL CHEMISTRY

Dr. E. M. Bailey, in charge

The Department of Analytical Chemistry is chiefly concerned with the examination of fertilizers, feeding stuffs, foods, drugs and insecticides as required by State statutes relating to these materials. It is also charged with the checking and certification of glassware used in testing milk and cream by the Babcock method; and with the checking and certification of thermometers used in the control of the pasteurization process in milk plants. Except in the case of fertilizers, enforcement of the statutes concerned is the responsibility of the Dairy and Food Commissioner; but this department collaborates with him in the formulation of rules and regulations for carrying out the provisions of the several statutes. The department also does a large amount of analytical work for other State agencies, notably the Storrs Experiment Station, the Commissioner on Domestic Animals, the State Supervisor of Purchases and some for other departments of the Station.

Foods and Drugs

Bulletin 447, Report on Food and Drugs, September, 1941, summarizes examinations of 1,436 samples of foods, drugs and miscellaneous materials, including samples submitted by the Dairy and Food Commissioner for regulatory purposes. Beverages, olive oil, meat products, vitamin D milk and fruits for spray residue were the chief items investigated. In the six-year period, 1935 to 1940 inclusive, 90 percent of vitamin D milk samples examined have substantially met or exceeded the unitages of vitamin D claimed for them. The daily production of this milk is about 16,000 quarts. Examinations of apples for spray residue have been confined to determinations of lead, except in special cases. About 100 samples were tested and none exceeded the new lead tolerance of 0.05 grain per pound of fruit announced by the U. S. Public Health Service and adopted by the Food and Drug Administration for the 1940 harvest season. It is estimated that, for the ten-year period of 1931-1940, only 4 percent of samples examined would have exceeded the tolerance of 0.025 grain per pound. Fewer, if any, would have exceeded the latest liberalized limit above mentioned. A survey of sedative drugs begun in 1939 was completed during the past year.

Fertilizers

Sixty-one firms registered 332 brands of fertilizers for sale in this State for the year 1941. Seven hundred and ninety-four samples

were analyzed. This number includes samples examined for purchasers and home mixers as well as those taken in official inspection. Tonnage for the period July 1, 1940, to June 30, 1941, was 61,597 tons, practically the same as for the pervious year. Roughly one-half of this represents mixed goods and the remainder is about equally divided between vegetable meals and other raw materials. Of the mixed fertilizer tonnage, 21,450 were of the ratios and grades recommended for Connecticut; 1,533 tons were of miscellaneous grades supplying 20 units or more of plant food to the ton; and 6,792 tons were of grades supplying less than 20 units. Tonnage figures do not include fertilizer materials distributed by the government under the Agricultural Adjustment program.

Feeding Stuffs

Bulletin 443 covers feed inspection for the year 1940. One hundred and eighty-six firms registered 1,208 brands of commercial feeds, including 25 brands of vitamin D carriers for poultry feeds. A total of 1,815 samples was examined, of which 910 were for official inspection purposes, 680 were pasture grasses for the Storrs Station, and the remainder including material to be examined for poisons, were submitted by purchasers. Of 59 specimens of animal tissues, etc., poisonous substances of possible or probable significance were found in 23. Lead and arsenic were the principal poisonous metals, suggesting access to paint or to arsenical insecticides.

Commercial feeds are sometimes suspected as the cause of sickness or death of farm animals but our experience over many years in examining such feeds for common poisons does not warrant such suspicion. Of the official samples of feeds examined, 97 percent of the guaranties made (protein, fat and fiber) were fully or substantially met.

Of 56 samples of vitamin D carriers examined, 16 were distinctly below the D unitage claimed. This is a greater proportion of deficiencies than was found in the two previous years. A probable explanation lies in the changing sources of supply of vitamin D oils. Due to unsettled market conditions adequate control by manufacturers is more difficult.

The routine testing of vitamin D carriers for poultry feeds has led to studies of the best conditions for the operation of this test. Considerable work has been done in collaboration with other institutions in which this type of work is being carried out and, in addition, this laboratory has conducted tests directly planned for the application of statistical methods of analysis to the data obtained.

Insecticides

A compilation of analyses of insecticides, fungicides and related materials was published in Bulletin 398 (1937). Circular 136 was issued in 1939. Since then, 81 samples, including arsenicals, copper,

lime-sulphur, nicotine, pyrethrum and rotenone preparations, mineral oils and emulsions, and miscellaneous products, have been examined.

Babcock Glassware

As required by Sections 2463 and 2488 of General Statutes, 2,697 test bottles and pipettes, used in testing milk and cream by the Babcock method, and 182 thermometers, used in milk pasteurizing plants to check recording thermometers, have been tested. Two pieces of Babcock glassware and 9 thermometers were inaccurate.

Miscellaneous

Collaboration with other State and Station departments has necessitated analyses of foods for the State Supervisor of Purchases, of narcotics for the State Department of Health, and of various specimens in connection with investigations by the Station departments of Botany, Forestry, Entomology, Soils and the Tobacco Substation. Samples for the year totaled 466 in all. Similar work for the Storrs Station has already been cited under a previous heading (Feeding Stuffs). Assistance has been given the Dairy and Food Commissioner in preparation of regulations under the Food, Drug and Cosmetic statute; and editorial work has been done for the Association of Official Agricultural Chemists and the American Public Health Association in the revision of texts on methods of analysis sponsored by these bodies.

BIOCHEMISTRY

Dr. H. B. Vickery, in charge

Plant Organic Acids

The development in recent years of accurate chemical methods to determine malic, citric and oxalic acids in plant tissues, together with a method to determine the total acidity due to organic acids, has for the first time permitted exact measurements of the quantities of these several acids in plant tissues. It has been found that only a part of the acids present in most tissues can be definitely identified. In the tobacco leaf, grown under usual field conditions, about one-fifth of the acidity arises from acids of unknown nature, while in tobacco leaves grown under certain experimental conditions this proportion may be as great as one-half. In other species, the unknown acids frequently predominate. If the organic acids of the leaf are involved in the chemical processes whereby both carbohydrates and proteins are produced, as present-day speculation on the intermediary metabolism in plants would suggest, it is clearly essential to identify as much of this unknown portion of the organic acids in leaf tissues as possible. To this end, studies on the analytical determination of succinic acid and on the distribution of this acid in various plants have been conducted. Succinic acid has been found to be widely

distributed in many species, but is seldom or never present in substantial proportions; it can account for only a small part of the unknown acidity in most cases that have been examined. This acid, which has been known for centuries as a product of the distillation of amber, is closely involved in modern theories of the mechanism of tissue respiration not only in plants but also in animals. It is probably universally distributed in living cells.

Proteins and Amino Acids

Analytical studies of a series of proteins prepared from the seeds of a number of plants belonging to the cucurbit family have been completed. The globulin of the squash seed was long ago prepared by Osborne at this Station. Methods developed from his original procedure have been applied to the seeds of the three species (*Cucurbita pepo*, *C. moschata*, and *C. maxima*) which include the plants commonly known as pumpkins and squashes. In addition, single varieties of cucumber and cantaloupe and two varieties of watermelon have been studied. Amino acid analyses of the crystalline globulins prepared from all of these seeds have shown that those derived from the three Cucurbita species cannot be distinguished from each other from the evidence at hand, but these proteins differ from those derived from the other seeds. In turn, the proteins of cucumber, cantaloupe, and watermelon seeds have been shown to differ from each other. Previously it had been held that the main globulins of the seeds of the various well known kinds of cucurbits are closely alike, if not identical with each other.

A new method to prepare the basic amino acid, histidine, has been worked out, taking advantage of observations by Bergmann on the solubility of the salts this substance forms with a number of aromatic sulfonic acids. It has been found possible to precipitate histidine directly from an hydrolysate of red blood cells by means of 3,4-dichlorobenzene sulfonic acid. This reagent is easily prepared from *o*-dichlorobenzene, a substance which is closely allied with the *p*-dichlorobenzene widely used as a moth repellent. The new method makes histidine far more readily available than hitherto. This amino acid is the source of an important drug frequently used in medicine.

The amino acid amide, glutamine, which is found widely distributed in plants, and is especially plentiful in beet roots, was extensively studied here a few years ago. This substance has recently been reported in the literature to be an essential constituent of the nutrient media upon which certain important bacteria are grown. No substitute for it has been discovered. Glutamine is now being prepared by at least one chemical manufacturer by the process earlier developed in this laboratory, and numerous requests for specimens of it have been received by the Station.

Asparagine, a closely related amide, which is also widely if not universally distributed in plant tissues, is also of great importance

as a constituent of certain bacteriological media. Accordingly the preparation of asparagine is being studied, since it has been previously available in this country only through importation from Europe.

Nutrition

The further investigation of the nutritive properties of the globulin of watermelon seed has led to disappointment. This globulin, on continued study, has been found to be definitely inferior to edestin in its capacity to promote growth. Most of the experimental animals suffered from diarrhea during the period that the globulin was fed, and a few of them died from no definitely determined cause. The conclusion was drawn that this protein cannot successfully be used as a substitute for edestin. Fortunately, however, the globulin of the seed of *Cucurbita moschata*, one of the common pumpkins, was found to promote rates of growth essentially the equal of those obtained with edestin, and no difficulties such as those mentioned were encountered. Although more extensive study is still required, the conclusion appears justified that this protein, or one of those from an allied species, will serve as a substitute for the edestin that is no longer easily available for nutrition work.

That the difficulties with watermelon seed globulin are not due to the presence of a toxic factor in either the seed or the protein has become evident from experiments in which the ground whole seed was fed to rats as their sole diet. These animals grew and displayed no untoward symptoms. The same was found with the whole seeds of the pumpkin. These observations are a contribution to the information being accumulated on the nutritive properties of whole seeds.

The general problem of the relation of age to the utilization of calcium as affected by the ingestion of oxalates has been continued. It was pointed out last year that there is very little disturbance of bone calcification when oxalates are fed to mature rats. This is in distinct contrast to the well-known behavior of young growing rats, in which there is a greatly lowered utilization of calcium in proportion to the oxalate fed, whether the oxalate is supplied in plant tissue or as a chemically pure salt. Work this year has been directed toward an attempt to determine the age at which a growing rat can consume large quantities of oxalate without disturbing the formation of bone.

ENTOMOLOGY

DR. R. B. FRIEND, in charge

The activities of the Department of Entomology fall into two categories, (1) the research on insect pests, and (2) the regulatory and control work as prescribed by statute. To properly fulfill its functions, it is essential that the department know what insects are

present in the State, which species are economically important and by what methods these pests may be circumvented.

Pests of Vegetable Crops

European Corn Borer

A second season's control work on a commercial basis gave encouraging results. One acre of extra early sweet corn, dusted according to a standard schedule, yielded a net return above dusting cost of $159 more than the return from an untreated acre. Since similar results were secured in 1940, the treatment of early sweet corn to control the borer appears to be economically sound. However, from a standpoint of both economy and efficiency the methods of control now in use will stand improvement. The problem has been attacked from several angles.

During the last two years the habits of the borer in the corn plant have been studied with the object of improving control methods. Adult moths deposit few eggs on small plants (Marcross and Carmelcross varieties), and few of the borers which hatch from those deposited are able to survive. The growing tassel is a location favored by the young borers until its buds begin to open to expose the anthers, when the borers migrate downward to enter the stalk or developing ears. The ears become at this time the location most preferred. The ear infestation thus arises from young borers which enter the ears or ear shoots immediately after hatching and from older borers which have migrated down from the drying tassel. These observations suggest that the first application of an insecticide should be made when the plant reaches the stage just prior to the appearance of the tassel tip inside the whorl. It would seem that the application of sprays or dusts to the developing ears alone should give good control, but field tests of this have given conflicting results.

Squash Vine Borer

The squash vine borer is particularly injurious to winter squash. Previous observations indicated that vines which attain some size by the time the borer appears may be resistant to injury. "Delicious" squash was planted May 1, May 15, and May 30 in order to test this possible relation of date of planting to injury. No significant difference in yield between May 1 and May 15 plantings was obtained. The May 30 planting produced about 30 percent less fruit than the previous plantings. This difference was probably due more to cultural conditions than to borer injury, although the latter was a factor. The general borer infestation was so light that insecticidal treatments did not produce such striking results as are sometimes obtained. Rotenone dust, applied at weekly intervals, appeared to be the most effective of the materials used.

Insect Pests of Fruits

Oriental Fruit Moth

In 1940 the results attained with xanthone (Genecide) for the control of the fruit moth were promising. This year field experiments with this material in the Hale orchard in Oxford showed the same trends, although the population of fruit moths throughout the orchard was so low that there was not much difference in infestation between sprayed and unsprayed trees. A low population prevailed in peach orchards throughout the State. Parasitism by Macrocentrus, and by other species as well, was relatively high. During the season we supplied 226 colonies of *Macrocentrus ancylivorus*, totalling 69,645 individauls, to 89 peach growers.

European Red Mite

The European red mite increases rapidly in numbers shortly after a setback brought about by the application of certain sprays. This may be due to the elimination of the natural enemies of the mite by the spray material. Flotation sulfur, for example, is one of the worst offenders. Some new summer sprays which have been tried are more promising for mite control than either sulfur or oils. During the summer the Federal Bureau of Entomology and Plant Quarantine, in cooperation with the Station, carried out certain studies on predators of this mite. Its investigators have made accurate estimates of predator populations in conjunction with our spraying experiments and elsewhere.

Insecticides for Orchard Use

One of the principal projects in relation to fruit insects is the study of insecticides for orchard use. Dinitro-o-cresol and dinitrophenol combined with oils for the control of mites and aphids were promising in preliminary tests. Rotenone-containing dusts, which have shown promise in apple maggot control since 1939, gave substantial reduction in fly population and fruit infestation. A mixture of aluminum aceto-borate and lead arsenate with and without a fungicide gave good pest control and adhered unusually well without causing any foliage injury. The experimental plots received only three spray applications and produced over 90 percent clean fruit.

Japanese Beetle

In addition to the usual observations on the abundance and injuriousness of the Japanese beetle, the work with this insect is divided into three phases: (1) distribution and establishment of parasites; (2) control of adults and larvae by use of insecticides, (3) quarantine and control administration. In general the beetle was somewhat more abundant than in 1940, although the heavy infestation remained discontinuous over the State.

Insect Pests of Shade and Forest Trees

Gypsy Moth

The gypsy moth control operations were carried out as usual, with the close cooperation of the Federal Bureau of Entomology and Plant Quarantine and the Civilian Conservation Corps. In the scouting work particular attention was given by State crews to nurseries and their environs in the heavily infested area in order to lower the hazard of spread from such sources. It was found necessary to spray in the vicinity of some of these nurseries, particularly in the towns bordering the Connecticut River, where the general infestation was heaviest. The Bureau of Entomology and Plant Quarantine, in cooperation with the C.C.C., sprayed certain areas in northwestern Connecticut, using both ground machines and an autogiro. Ten additional towns in eastern Connecticut were type-mapped.

Dutch Elm Disease

The Dutch elm disease scouting and control work has been carried out mainly by the Federal Bureau of Entomoloy and Plant Quarantine. Due to restrictions on funds and labor, the general procedure was modified in 1941. In the generally infested part of the State scouting was limited to areas containing so-called valuable elms, that is, those useful as shade and ornamental trees. A peripheral zone around the generally infected area was, however, thoroughly scouted. The cooperation of tree wardens and commercial arborists was solicited in detecting and caring for diseased trees. Infected elms were found for the first time in 11 new towns along the border of the old infected area. No diseased trees were found in Preston, and no excessive outbreaks of the disease were discovered.

European Pine Shoot Moth

The European pine shoot moth continues to seriously injure red pine plantations in Connecticut. The study of population fluctuations in the plantation at Guilford is being continued. During the winter and early spring the gypsy moth crews examined all red pine plantations in a zone two towns deep along the northern border of the State. The owners of nine heavily infested plantations, containing a total of 15 acres, were notified of the condition of these stands and advised to undertake control measures.

White Pine Weevil

The study of the relation of growth and pruning methods to the recovery of white pine from weevil injury has been continued at Rainbow, Conn., and at Keene, N. H. The development of compression wood, which forms a serious defect in the lumber unless the injured tree straightens rapidly, received particular attention.

Soil and Grassland Insect Investigations

Scarabaeid Larvae

Turf over considerable areas is frequently severely injured by scarabaeid larvae. The Japanese beetle, which has been discussed previously, may become the worst pest of lawns, golf courses, and permanent pastures Connecticut has experienced. During 1941 May beetle (*Phyllophaga* spp.) larvae killed the turf on golf courses and in cemeteries in several parts of the State. The habits of these scarabaeid beetles are similar and they are all subject to the same general methods of control. The relations of fertilizer applications to the effect of lead arsenate, used as a soil poison, on the larvae and on the grass are being studied.

Studies of Dusts

The settling of dusts and their tenacity on foliage are important factors in their efficiency. In an experiment conducted in cooperation with the Department of Plant Pathology and Botany preliminary results of dusts made in a laboratory settling tower have shown substantial differences in settling rate of diluents commonly used in dusts.

Studies of tenacity indicated that no diluent resisted washing when it was dusted on a dry surface. On wet surfaces the tenacity of the various diluents varied greatly. Furthermore, there was an indication that poor tenacity of a portion of a dust actually reduced the amount of residue of fractions with better tenacity. The fractions which settled most slowly in the tower showed the best tenacity in all cases.

Rodent Control

The Fish and Wildlife Service, United States Department of the Interior, has continued its cooperative research program with the Connecticut Agricultural Experiment Station during the year 1941. The research dealing with the ecology, life history and control of pine mice (*Pitymys pinetorum*) has been the major project.

Inspection of Nurseries, Imported Nursery Stock and Apiaries

During the summer 359 nurseries with a total area of 4,782 acres were inspected in compliance with Section 2136 of the General Statutes. The usual number of insect pests and plant diseases were found, most of them of minor importance. No imported nursery stock was inspected this year, the European war having stopped shipments.

For the past several years the two apiary inspectors have been unable to inspect all apiaries in the State in any one season. A third inspector was appointed on July 1 of this year and the efficiency of this service greatly increased. All the colonies found infested with foul brood were either treated or destroyed.

FORESTRY

W. O. Filley, in charge

Much time and thought have been devoted to the Connecticut fuel wood program, in which all local agencies involved in forestry are cooperating. The special part taken by the Station was the design and development of an improved type of portable charcoal kiln.

Portable Charcoal Kiln

There is a constant and fairly large demand for charcoal throughout Connecticut, particularly among tobacco growers who use it for heating sheds during the curing season. In recent years very little charcoal has been made in Connecticut, and the demand has been filled by the by-product kilns which operate in Pennsylvania. Because of the Defense Program, this supply is virtually shut off. The production of charcoal in Connecticut is a logical use of low-grade thinnings from our hardwood forests and at the present time offers not only an opportunity for marketing these thinnings, but also a means of encouraging the improvement of woodlots. The State Forestry Department had already experimented with stationary brick kilns of the beehive type, but these have certain limitations because of the necessary size and the labor involved in burning and removing the charcoal. A smaller unit that could be moved from place to place seemed to offer a satisfactory solution.

In May, 1940, it was decided to build a portable kiln of two to four cords capacity, patterned after the Swedish chimney type. In this we had the active cooperation of the State Forestry Department and the Northeastern Forest Station of the U.S.D.A. Three kilns, varying in capacity from one to four cords, have been built and operated successfully. Station Bulletin No. 448 describes the construction and operation of these kilns.

Uses for Native Wood

Another large market for native wood exists in the posts used in highway guard rails and other fencing. For many years, chestnut was a standard fence post material, but this has disappeared due to the blight. A series of tests of other native species made by the Station revealed the fact that many of them are as strong or stronger than chestnut, but few, if any, will resist decay for as long a time. This led to a long series of experiments on preservative treatments, the most recent of which is the impregnation of green wood with zinc chloride. A large number of posts treated by various methods have been placed in highway fences for test.

The Rainbow Experimental Forest

A new report was in preparation and final measurements were almost completed when the hurricane struck Connecticut on Septem-

ber 21, 1938. While the younger plantations at Rainbow were not destroyed, many of the older ones were, and the damage was heavy on 10 of the 75 plots. The immediate task was to secure final measurements on all down trees and to salvage as much as possible of the experiments terminated by the storm. This work has been completed. The report planned for publication in 1938 was delayed but the data needed was not irrevocably lost. About 70 percent of the plots were unharmed and this unique experimental project will go forward. A complete inventory was made on most of the older plots and these data are being compiled for inclusion in a new progress report.

Studies of Forest Plantations

A study of 20 permanent red pine sample plots has been in progress for 12 years. A third measurement on these plots will be made in 1942. Bulletin 413, Red Pine in Connecticut Forest Plantations, was published in 1938 from taper measurements taken while thinning these plots. Within the next fiscal period, it is planned to incorporate all the measurements into a bulletin on the growth characteristics of red pine in relation to site.

Distribution of Forest Planting Stock

For more than 30 years this project of the Forestry Department has been managed as nearly as possible on a self-supporting basis. Since 1925 the stock has been sold to farmers at a discount, for which reimbursement has been received from the U. S. Department of Agriculture under the Clarke-McNary Act. The total number of trees distributed in the spring of 1941 was 555,000. Of this total 88,000 (16 percent) were sold to farmers under the Clarke-McNary Act. About 50 percent of the total was white and red pine; 25 percent was Norway and white spruce, and 16 percent Douglas fir.

Other agencies, including the Soil Conservation Service and the Agricultural Conservation Program, are now interested in the distribution of forest planting stock. This has complicated the situation and it seems best for the Station to give up this activity. The General Assembly authorized the State Forester to assume it, and provided the funds for the purpose. It will be one year, or possibly two, before the Station can give it up entirely.

Control of White Pine Blister Rust

During the calendar year 1941, the Station continued cooperation with the U. S. Department of Agriculture in the control of this disease. Since it can only spread from pine to pine by means of currant or gooseberry (Ribes) bushes in close proximity, the eradication of these alternate hosts provides an effective means of protection. Such work is carried on in all states where white pine is an important timber tree.

During 1941, the eradication work of white pine blister rust was carried on by men from the CCC camps and by local labor. WPA labor has not been available for this project since December 31, 1940. Eradication was done in eleven towns with a total of 60,102 Ribes bushes removed. The total area worked was 49,342 acres giving protection to 7,097 acres of white pine. In addition to the organized town control work nursery sanitation work has been carried out surrounding six nurseries in which white pine is raised; 11,893 Ribes were removed at the expense of the nursery companies.

GENETICS (PLANT BREEDING)

Dr. D. F. Jones, in charge

Hybrid Field Corn

Due to rising feed costs and uncertainty of transportation, interest is increasing in corn for grain in Connecticut. With larger demands for dairy products, greater amounts of corn will be needed for silage. Corn trials during 1941 included new varieties of hybrid corn in a preliminary observation test. These consisted of various combinations of new Connecticut inbreds with the most promising of the western inbreds that in repeated trials have been shown to be adapted to this region. Seed has been produced at the Experiment Station farm, by cooperating farmers in Connecticut, and at Feeding Hills, Massachusetts, by the Eastern States Farmers' Exchange. From these trials a recommended list of hybrid varieties was prepared, as in other years, and will be sent on request to all interested.

Hybrid Sweet Corn

To the three early sweet corn hybrids—Spancross, Marcross and Carmelcross, released previously and now widely grown—have been added three new varieties which are designed to follow these early hybrids. These are Lexington, Lincoln and Lee. Named according to a new system whereby their association in American history suggests their approximate season of ripening, Lexington is early, and Lincoln and Lee are mid-season. All in this series are designed as market garden varieties, producing large well-filled ears of good quality. They have strong erect stalks and are resistant to disease. Lincoln won an award in the All-America vegetable trials for 1942. As in previous years, the new sweet corn varieties are described in a circular, Number 148.

Beets

A further study of environmental influences on the pigment and sugar content of garden beets has been made. Data have accumulated to show the effects of soil and nutritional differences. Lines are being inbred by open-pollinated sib mating in isolated locations.

Squash

Yankee Hybrid, a new first generation hybrid summer squash, introduced in 1940, was given extensive tests in 1941. Many samples were sent to Experiment Stations, seedsmen and growers throughout the country. This hybrid was reported by almost everyone who grew it to be earlier and more productive than Early Prolific Straightneck.

Selections from the original Yankee Hybrid have been carried into the third generation. Some of these selections are decidedly earlier than the original hybrid. This indicates that new true breeding lines can be established which may be earlier than the first generation hybrid.

In 1941 several new combinations of first generation hybrid squash were grown in observation plots. None of these were earlier than Yankee Hybrid but several were much more productive through the first week's picking.

The possibilities of using second generation hybrid squash seed for commercial planting were tested further in 1941. One market gardener grew about two acres of this crop in 1941 with good results.

Breeding work has been started for the purpose of developing bush types of Hubbard and Table Queen varieties of winter squash. Such types would be highly desirable for small gardens and the total yield per acre would be materially increased in larger plantings by the larger total number of plants.

A new type of squash has been grown which has a hullness seed. This variety has been known in the Balkan states of Europe for the past 50 years where it is extensively grown for its oil. It may be found to be useful in this country for the baking industry or as a new kind of "nut."

Tomatoes

There is no other vegetable crop receiving more attention from the plant breeder and the pathologist throughout the country than tomatoes. We have developed several lines with standard vines and handsome fruit. One of these lines has the particularly desirable characteristic of being able to keep the fruit covered with new foliage, even when the older leaves are killed by the alternaria leaf spot. New shoots come out along the main stems in sufficient numbers to shade the exposed fruit and to supply food for the immature fruit. No early varieties are known to be resistant to these leaf spot diseases.

Peppers

Success with the project to develop an early thick-fleshed, deep red, productive sweet pepper is at hand. Fourth and fifth generation selections from hybrids in which Windsor A and B were crossed with Oshkosh will be grown at Mount Carmel in 1942 in picking trials for final selection and for seed increase.

From our results with second generation hybrid squash seed we are experimenting with second generation pepper seed for commercial planting. If the second generation crop of peppers is no less vigorous than second generation squash, then it may be practical to use the second generation pepper seed for commercial planting.

Strawberries

The 1941 strawberry trials were grown for the first time in a Latin square yield test in which were included the nine most promising varieties selected from previous trials. In addition 50 varieties were grown in a preliminary observation trial. Differences in yield of less than 18 percent in these trials were not considered significant.

Three new varieties originated by this Station have been released to nurserymen and plants are available for production in Connecticut and elsewhere. These are Shelton, Hebron and Bristol. The last has not yet been described in a formal publication. It is outstanding in attractiveness and quality of fruit but is not sufficiently productive to justify extensive planting. However it warrants testing under a wide range of conditions to determine where it can be grown to advantage. The comparative yields of these three varieties contrasted with the most productive ones already available are given in a yield report for 1941.

Genetic Principles

Inbred strains of corn can be noticeably improved in their growth and production as inbreds but, in nearly all cases, their combining ability with other inbreds is not improved in hybrids, and is often impared. The transmission of combining ability is being studied and a system of testing is being devised to select for combining ability. These investigations have been aided by a grant from the Eastern States Farmers' Exchange.

Numerous changes in color and chemical composition of the aleurone and endosperm in highly aberrant stocks is being carried out. The number of chromosome aberrations varies in different lines. A statistically significant difference in the number of chromosome aberrations in the endosperm has been found when control pollinations were made on the same female parent. The pollinations giving many spontaneous endosperm changes had 4.57 percent chromosome aberrations, which was 3.24 percent more than the pollinations giving few if any endosperm changes. Genetic lines having the normal order of the genetic markers, inverted and changed with respect to other markers, are being used to give further proof of the origin of the endosperm aberrations in the chromosome behavior.

Sterility factors affecting pollen and ovule abortion have been located on the chromosomes and a further study made of their effects. Microscopic investigations of developing pollen grains of corn have been carried on since 1938 in order to determine causes of sterility

in some inbred and hybrid lines. Some of the determinations were made incidental to a study of chromosome morphology. Others were included in 26 semi-sterile ears found in a collection of 14,916 ears examined in field corn trials. Several types of aberrations have been found including lack of typical pairing of chromosomes, inversions of regions of chromosomes and reciprocal exchanges between different chromosomes. All of these give recognizable types of pollen and ear sterility. These data, which will be published in detail, are of interest since some of the sterility types occur frequently when corn is inbred.

Growth changes have been found to be associated with chromosome breaks and relocations at particular places. These seem to be due to interactions at the points of contact rather than to an accumulation of growth regulating genes. They are being studied further.

Reciprocal translocations among the chromosomes of a uniform long inbred strain of dent corn were induced by X-ray treatment applied to the pollen. Plants heterozygous and homozygous for these translocations were grown and studied statistically in comparison with the original untreated plants. Small but significant differences are noted in height of plant, diameter of stalk and time of flowering. In most cases these changes from normal represent losses in efficiency of growth. In a few cases increases have occurred. Whether these are due to interactions at the points of new contacts, or to alterations induced at other points on the chromosomes, remains to be determined by backcrossing to the normal line.

A large number of progenies of the long inbred strains of maize was grown in an effort to find naturally-occurring changes in the rate of growth, or in form, particularly those variations that might be favorable to the plant. Progenies have been found which are later in maturity than the others. One line has proved to be earlier in maturity, taller in growth and more productive of grain. The nature of these variations is being studies. These investigations have been aided by a grant from the Rockefeller Foundation.

PLANT PATHOLOGY AND BOTANY

Dr. J. G. Horsfall, in charge

Vegetable Crop Diseases

Defoliation of tomatoes, caused by *Alternaria solani* has been intensively studied here for some years. This disease caused heavy damage in 1941, and its presence offered good opportunity for extended experiments. It was demonstrated that susceptibility of tomatoes to this disease is directly related to the fruit load. The longer the plant remains free of fruit, the longer it remains free of Alternaria; and the more fruit it sets, the more susceptible it becomes.

A critical experiment on spray coverage showed that it is better to apply a small amount of protectant in a large amount of water through a large nozzle orifice, than a large amount in less water with a small nozzle orifice.

Apple Scab Control

The search was continued for better fungicides to control apple scab. The three problems under consideration were: To find an acceptable substitute for sulphur as a fungicide on apples; to establish the degree of correlation between field and laboratory tests of fungicides; and to determine the nature of the relationship between dosage and control.

It has developed that tetramethylthiuram disulphide and ferric dimethyl dithiocarbamate are promising for apple scab and cedar rust. Mercapto benzothiazole gave reasonably good control but it did not appear as promising as the other two.

Tests of many fungicidal materials showed that their value in the field was approximately the same as in the controlled laboratory experiments. The sulphur dosage experiments yielded a definite correlation between dosage and disease control.

Fungicide Shortage

Copper, mercury, and formaldehyde are distressingly scarce just now and it will be necessary to reduce their consumption in fungicides. Fundamental research on fungicides at this Station can now be applied. Until recently no one knew the relation of quantity of material to the control obtained, but this has just been learned for some materials. Only half as much copper as yellow oxide, for example, is required for control as red copper oxide. On the basis of these findings the manufacturer is taking red oxide off the market and substituting yellow in order to give his customers the required disease control with less copper.

On the basis of research with fruits, vegetables, and roses it is clear that tetramethylthiuram disulfide, ferric dimethyl dithiocarbamate, mercapto-benzothiazole, and tetrachloro benzoquinone will be useful substitutes for much copper, mercury, and probably formaldehyde that is now consumed for fungicidal purposes.

Through its connections with the War Emergency Committee of the national society of plant pathologists it seems probable that the Station will contribute still more in 1942 to this pressing problem.

Results of the testing of fungicides by the Station in the laboratory and field are presented in Bulletin 451, now in press.

Dutch Elm Disease

Some hope for controlling the dreaded Dutch elm disease is seen in the results of work in progress for the past two years. Data in-

dicate that a toxin formed by the Dutch elm disease fungus is the primary cause of the disease symptoms. Retardation of the progress of the fungus in small elm trees has been effected by the injection of certain organic chemicals.

Proceeding on the theory that the Dutch elm disease fungus produces a toxin that is responsible for the disease symptoms, a chemical was sought which could be injected into the plant tissue to counteract the toxin or kill the protoplasm of the fungus, without producing deleterious effects on the tree itself. During the past two seasons approximately 850 small American elm trees, and 25 larger ones, at the New Haven Station have been treated with a number of organic chemicals in attempts either to prevent or control Dutch elm disease.

Of over 100 organic chemicals, five or six have shown promise in retarding the progress of the Dutch elm fungus in small (3-6′ tall) elms, or in preventing growth of the fungus if applied before the trees become infected. Injected into trees at the time of the appearance of the symptoms of Dutch elm disease, benzoic acid, hydroquinone and 8-hydroxyquinoline benzoate were effective in slowing down the progress of the disease. For ten trees injected with one application of benzoic acid, the average increase in percent of the individual tree diseased from July 1 to October 1, 1941, was 5.4 percent, compared to 56.5 percent for the water-injected controls, and 67.5 percent for uninjected controls.

One distinct handicap in dealing with this disease, as with many others, is that once the disease becomes well established the possibilities of checking its advance by chemotherapy are considerably diminished. Results of the past two years indicate that chemotherapy methods offer hope of curing such diseases as Dutch elm disease, but the work is still in the preliminary stage. Further experimentation is being planned with the promising chemicals used the past year, and with other similar compounds.

X-Disease of Peach

Since early in our investigation of the X-disease of peach, efforts have been directed toward inactivating the virus in the living tissue with chemicals. This virus offers more possibility of inactivation, perhaps, than others such as tobacco mosaic, because it seems to be unstable. It can be transmitted only by budding or grafting and not mechanically with infectious juice as in the case of tobacco mosaic, possibly because the X-disease virus is inactivated by exposure to air.

On this hypothesis the disease offered a promising opportunity for trying internal chemotherapy as a means of inactivating a virus.

The data show that some of the chemicals, notably quin-hydrone, 8-hydroxy-quinolin sulfate, hydroquinone, p-nitrophenol and calcium 8-hydroxyquinolate inactivated the virus in many of the diseased

buds with a consequent failure to transmit the disease to healthy plants. The untreated diseased buds and those treated with some of the chemicals failed to show inactivation of the virus as indicated by the ability of those buds to transmit the disease.

It is not possible at this time to say that the inactivation of the virus is permanent but, if one is to judge by the performance of the plants in the similar experiment conducted in 1940, it would be safe to assume that it is. The plants in this previous experiment showing no infection in 1940 were still showing none at the end of the 1941 growing season.

Seed Testing

Cooperating with the Commissioner of Agriculture, who collects the samples and administers the Seed Law, the laboratory has completed the following tests:

	Germinations	Purity
Vegetables	1400	
Field Seeds	180	180
Graded Lawn Mixtures	28	28
Ungraded Lawn Mixtures		66
Hay and Pasture Mixtures		10
Total	1608	284

In addition, 192 germination and 47 purity tests were made for State institutions and citizens.

Investigations are in progress on problems of seed germination. The effects of storage conditions, various substrata, temperature during germination tests, and moisture on the germination of spinach seed are under consideration. Another series of studies is being conducted on mechanical injury to seeds and its influence on germination. A chemical test with selenium salts for rapid determination of seed viability is being studied and has given a high degree of correlation with actual germinations.

SOILS

Dr. M. F. Morgan, in charge

Soil Testing

A considerable increase in the number of soil samples submitted for analysis at New Haven and Windsor has been noted in the fall of 1941, due mainly to the long open fall. The total for the year however is about the same as usual, a little over 4,000 having been tested at Windsor and approximately 2,000 at New Haven.

Bulletin No. 450, Chemical Soil Diagnosis by the Universal Soil Testing System, a revision of Bulletin 392, describes the quick test

system of soil examination which is used on most of the soil samples submitted to New Haven and Windsor. This system was devised by Dr. Morgan in 1933 and has become extensively adopted in laboratories in many other states and numerous foreign countries.

"Quick test" chemical methods similar to those developed at this Station are now extensively used in most eastern and southern states for estimating the nutritional factors of soil fertility. Wherever they have been applied to a sufficient number of soils to provide a broad base of reference on many soils of known fertility, they are giving invaluable aid in the more efficient use of fertilizers. Interpretations of such tests must be standardized on the basis of local experience under definite agronomic conditions. Certain methods are more useful than others on very heavy "corn belt" soils, on highly calcareous soils, and on exceptionally sandy soils. Various methods now in common use, for a particular constituent, give similar *relative* results on most other soils.

Organic Matter and Nitrogen Maintenance Under Intensive Cropping Conditions

During the past year, soils that had been under study in the lysimeter experiments at Windsor for a 10-year period, have been analyzed in comparison with the soils in their initial condition.

Results show that soils kept bare of vegetation, without any nitrogen fertilizer, lose nitrogen at the annual rate of approximately 40 pounds per acre. This loss is due to leaching. The yearly destruction of soil organic matter is about 900 pounds.

The Effects on Connecticut Soils of Cultivation and Erosion

An effort has been made to compare soil qualities of land long under farm use with those existing in the woodland, under practically identical slope and original natural soil conditions. Of the nine locations selected, some were adjacent to fields in frequent cultivation, some had been in pasture sod or protective orchard turf for 40 years or more and others were farm woodlots that have never been completely cleared.

The two most significant features of superiority shown by the woodland soils are the uniformly higher amounts of organic matter and the greater porosity of the uppermost 6 to 8 inches of soil. Soils long in turf and soils frequently cultivated are not consistently different in these respects, although in general the former contain slightly more organic matter and are slightly more porous. Woodland soils are considerably higher in nitrogen and much better supplied with organic matter. Based on average results for the nine locations, farming during the past 150 to 250 years has resulted in a net loss from the soil of 42,000 pounds of organic matter when under frequent cultivation, and of 40,800 pounds, when kept under sod. Nitrogen

losses have been 624 pounds per acre, under cultivation, and 706 pounds per acre, under sod.

In other chemical respects, cultivated soils to plow depth were generally the most fertile. Pasture soils were generally depleted of phosphorus and contain less available potash as compared with either woodland or cultivated soils. The woodland soils were generally quite acid, indicating that soil depletion by farming is not the chief factor in the lime needs of soils, under Connecticut condtiions.

The woodland soils were from 2 to 18 inches deeper than the unweathered glacial deposits from which these soils are formed. On the average, it is estimated that the total soil and subsoil depth under cultivation is 9 inches less than in the woodland.

The results of erosion in Connecticut are rarely obvious on the surface. The productive capacity of the soil is maintained and often improved by the use of lime and fertilizer. But on lands of from 5 to 15 percent slope, the amount of potential soil depth appears to be diminished by from one-quarter to one-half of its original thickness.

Soil Maintenance for Vegetables

The increasing use of light soils in the Connecticut Valley for commercial vegetable growing presents many problems of soil management. Manure is seldom available and the use of this land is much more intensive than when tobacco is grown.

A new series of experimental plots was started in 1940 at Windsor, designed to determine the effects of rotational practices with respect to green manure, farm manure and two levels of nitrogen fertilization.

Potatoes were grown on an adjacent field in rotation with tobacco, clover and corn. Potatoes in alternate years with tobacco have given the best yields. Potatoes after clover, and after corn have shown less tendency to decline in yield than when grown continuously.

Forest Soils

Effect of Soil on Root Systems of Forest Trees

A study was made of the root systems of five species of trees which had been growing seven years on two distinct soil types—Merrimac loamy sand and Charlton fine sandy loam. It was found that the roots penetrated deeper and had a wider spread in the Merrimac soil, but the number of small feeding roots to a cubic foot of the top soil was greater in the Charlton. Soil from zones of high root concentration was slightly higher in nitrogen, organic matter and fine clay than was that from areas where roots were few or absent. White pine trees had the largest number of roots, the other species decreasing in the following order: red pine, Norway spruce, white ash, and red oak. Survival and growth were generally better on the Charlton soil.

Nutrition of Forest Nursery Stock

During the year additional data was obtained on experiments begun in 1939 and 1940 at Peoples Forest Nursery, and several new experiments were started, both in the nursery and in the field. In the seed bed experiment the results tended to confirm those obtained last year, namely, that liquid fertilizers (i. e. dissolved in water and applied as a solution in frequent light doses) high in phosphorus were more effective in increasing the growth of nursery stock than were other mixtures, and that nitrogenous fertilizers or mixtures high in nitrogen were generally ineffective and sometimes injurious. A top dressing of superphosphate and muriate of potash in the dry form on 2-0 stock was somewhat beneficial to Norway spruce but not to white pine.

At New Haven a set of 48 concrete soil frames containing identical soil at the start but variously treated for many years was seeded to white spruce in the spring in 1940. At the end of the 1941 growing season it was found that the most effective treatments were NPK (nitrogen, phosphorus, potash), PK, NP, and P. The poorest plants were found in the frames receiving lime but without phosphorus.

In the field, Norway and white spruce stock which had been fertilized in the nursery did not exhibit any conspicuous difference in growth over those not treated. Stock not especially fertilized in the nursery, but treated at time of planting in the field, showed at the end of the first season a slightly higher mortality when a dry, complete fertilizer was applied. Using starter solution—a practice which has found favor among some tomato growers—seemed to have a slightly beneficial effect on the growth of white spruce. Vitamin B_1, used alone, or with a complete fertilizer, had no influence on either survival or growth.

Effect of Slash

The first data from the slash disposal plots was obtained this year. The only effects on the soil noted so far are that slash tends to reduce the acidity slightly, and that burning reduces the acidity and tends to increase the available potash and magnesium content. Growth of white pine saplings was favored by the presence of slash on the ground. On the other hand a similar experiment on a block of rapidly growing red pine showed slightly less growth under slash than on areas free of slash.

TOBACCO SUBSTATION

Dr. P. J. Anderson, in charge

Over 25 research projects are now being carried on. No attempt is made here to discuss any or all of them in detail. Full reports are given in the annual report of the Tobacco Substation that is issued

as a special bulletin each spring. There follow brief accounts of some of the most timely results obtained during the past year.

Placement Trials

The standard practice in the Connecticut Valley is to broadcast the fertilizer for tobacco. Experiments on corn and other crops in many parts of the country have shown that less fertilizer is needed if it is properly placed in the row or the hill. In 1940 an elaborate experiment was begun to determine whether it is better to apply the fertilizer broadcast, or in bands on each side of the row. Included in the plan is a comparison of application at time of setting, with application 10 days in advance of setting.

Forty-eight plots are involved, requiring two acres of tobacco. The formula is approximately an 8-4-8. All methods and dates of applying involve three rates that correspond to 150, 175 and 200 pounds of nitrogen per acre.

The 1941 crop was much better and more uniform than that of 1940. The results for this year show no significant advantage for row over broadcast application; nor was there any difference between early application and that made at the time of setting. However, differences between the three rates of application are significant. Both yield and quality increased with the rate of application, up to the standard of 200 pounds of nitrogen per acre.

Relative Efficiency of Carriers of Nitrogen

Connecticut tobacco makes practically all of its growth in six weeks. We have made thousands of observations on the nitrates present in soil throughout the season. These show that for a satisfactory crop, nitrates must be present in abundance during these six weeks. Therefore, the choice of nitrogenous materials is of major importance.

The data show quite definitely that cottonseed meal is less efficient under the conditions stated above than are urea, castor pomace or soybean meal. In other words, 200 pounds of nitrogen in cottonseed meal must be applied to produce the same results as 175 pounds of nitrogen in the other materials. It seems evident that nitrates are not formed as rapidly from cottonseed meal during this period of six weeks as they are from the other materials under test.

Improvement of Shade Tobacco by Selection and Breeding

In 1940 seed was assembled from many sources and the resulting crops carefully observed. Many strains were obviously not suitable for Shade tobacco and were discarded; on the other hand, many showed promise. Not only were a large number of selections of individual plants made, but a number of crosses were made artifically. The F_1 generation of these crosses was grown during the past winter in the greenhouse, with the result that the F_2 generation was grown in plots in 1941, along with the selections.

"Black" Tobacco

This investigation is now in its second year. Many chemical analyses made this year confirm the earlier results, namely, that manganese and iron are present in "black" tobacco in greater amounts than in normal leaf. Last year this condition seemed to be correlated with higher acidity in the soil. However, the observations of 1941 on this point are not so consistent. It is possible that other factors are involved and a thorough search for these is being made.

Downy Mildew

This disease continues to be a problem in the beds, although not so serious as last year. Some new spray materials have been tried, including one called "Flordo," a copper soap spray. This gave the best control of any spray so far tried and is promising, although it burned the leaves very slightly.

New methods of using paradichlorobenzene were tested. In one of these the PDB was sprinkled on cloth frames set inside the beds. The cloth covers about half of each bed section. This gave excellent control, even better than the wire basket method.

TREE PROTECTION EXAMINING BOARD

The Connecticut Tree Protection Examining Board was created by the General Assembly of 1919 and for twenty years consisted of the Botanist, Entomologist and Forester of this Station. The General Assembly of 1939 added two members to be appointed by the Governor but the meetings of the Board continue to be held at this Station and all its records are kept here. It requires time and attention from three of the staff members and is in many respects a Station project.

The Board functions mainly as a licensing agency for commercial tree workers whose qualifications are examined and passed on by the Board members. There are over three hundred license holders and about a dozen new applicants each year. Raising the standards from time to time has made it increasingly difficult for laborers with little or no knowledge of the scientific principles underlying tree life and growth to secure licenses and practice as tree experts in Connecticut.

THE LIBRARY

During the year ended October 31, 1941, the Station Library had approximately the following number of additions:

U. S. Department of Agriculture publications	946
State Agricultural Experiment Station publications	1,373
Scientific and agricultural domestic and foreign journals	2,035
Single books purchased	64
Total	4,418

The total number of cloth and paper bound volumes on hand is now about 26,730. Most of the United States Department of Agriculture and State Experiment Stations publications, as well as scientific journals, are received in pamphlet form and are not included in the volume count until bound.

LIST OF PROJECTS
1941 - 42

Analytical Chemistry

1. Inspection of fertilizers.
2. Inspection of feeding stuffs. (Including biological assays of vitamin D supplements for poultry feeds.)
3. Inspection of food and drugs. (Including biological assays of vitamin D milk.)
4. Calibration of Babcock glassware and thermometers.
5. Analyses of insecticides and fungicides.
7. Analyses of special and miscellaneous foods.
8. Collaborative studies on analytical methods.

Biochemistry

1. Cell chemistry.
   a. A detailed examination of the constituents of plant cells, in particular those of leaf tissues. The further development of methods for the determination of the constituents in extracts of such tissues.
   b. Chemical investigations of the constituents of the tobacco and other plants with special reference to the changes that occur during culture under various conditions.
   e. The metabolism of the organic acids in plants.
2. Protein chemistry.
   a. The methods for the determination of the basic amino acids yielded by proteins with the object of increasing their accuracy and convenience.
   b. The methods for the separation of other amino acids yielded by proteins.
   c. The properties of certain of the amino acids and their derivatives.
   d. Methods for the preparation of pure proteins.
3. Nutrition investigations.
   a. The relation of diet to the rate of growth with special attention to certain factors that appear to determine rapid growth.
   b. The investigation of the relation of certain constituents of the diet, especially the mineral salts, to growth.

Entomology

9. Insect survey of Connecticut.
17. Studies on the control of the Oriental fruit moth, including parasites. (In coöperation with the U. S. Dept. of Agr.)
28. Investigations on oil sprays.
30. A study of insects that attack the tobacco plant. (In coöperation with the U. S. Dept. Agr.) (See also Tobacco Substation, No. 20.)
31. Studies on the biology and control of the European pine shoot moth.
37. Substitutes for lead arsenate in orchard sprays in apple maggot control.
38. The relation of rate of growth and pruning methods to the recovery of white pine to weevil injury.
40. Studies on the control of the European corn borer. (In coöperation with the U. S. Dept. Agr.)
43. The spruce gall aphid.
44. Bark beetles of the elm.

45. Investigation of parasites of the Japanese beetle.
48. Study of predators affecting the European red mite.
49. Adhesives for standard spray mixtures.
50. Control of the squash vine borer.
51. Soil and grassland insect investigations.
52. Study of wireworm injury to potatoes.
53. Rodent control. (In coöperation with the U. S. Fish and Wildlife Service.)
54. The natural history of a Collembolan (Tomocerus) and its relation to litter decomposition in forest stands.
55. The biology and control of *Calomycterus setarius* Roelofs.
56. Studies of dusts. (In coöperation with the Dept. of Plant Pathology and Botany.)
57. The biology and control of Comstock's mealybug on pears.

Control and Service

10. Inspection of orchards and nurseries.
11. Control of the gypsy moth. (In coöperation with the U. S. Dept. Agr.)
13. Inspection of apiaries.
19. European corn borer and Japanese beetle inspection. (In coöperation with the U. S. Dept. Agr.)
27. Rearing and distributing parasites of the Oriental fruit moth. (In coöperation with the Conn. Pomological Society.)
29. Dutch elm disease control. (In coöperation with the U. S. Dept. Agr.)

Forestry

1. Experimental plantations on a sandy tract at Rainbow.
   a. Comparison of many species of conifers and hardwoods, in pure stands and in combinations, as to growth and habits.
   b. Methods of management for those species that have survived.
   c. The properties of the wood of several of the important species. (In cooperation with the Yale Forestry School.)
6. Studies of forest plantations throughout the State.
   a. Growth and yield of several species in relation to site. (The present studies are on red pine, in coöperation with the State Forester and the Yale Forestry School.)
   b. Properties of red pine wood grown in plantations. (In coöperation with the Yale Forestry School.)
12. The utilization of native woods. (In coöperation with the State Forester, State Highway Dept., Conn. Forest & Park Assoc., Yale Forestry School, and U. S. Forest Service.)
   a. Preservative treatments of posts and other materials.
   b. The development of a portable metal charcoal kiln.
   c. The use of hogged wood as a fuel.

Control and Service

5. Distribution of forest planting stock. (In coöperation with the U. S. Dept.) Agr.
7. Control of white pine blister rust. (In coöperation with the U. S. Dept. Agr.)

Genetics (Plant Breeding)

1. A genetic and cytological study of hereditary characters in plants.
2. The effect of inbreeding and crossing upon seed and vegetatively propagated plants.
3. Methods for the improvement of naturally cross-fertilized plants by selection in inbred lines.
4. Methods for the improvement of naturally self-fertilized plants.
5. A genetic and physiological study of variation and the effects of selection in vegetables and fruits.

Plant Pathology and Botany

5. Plant disease survey of Connecticut.
20. Diseases of shade trees.
27. The Dutch elm disease and related diseases.
28. Studies on the identification of apple varieties by seed characters. (Inactive)
30. Diseases of vegetable crops and their control.
    a. Downy mildew of muskmelons and cucumbers.
    b. Defoliation and related diseases of tomatoes.
    c. Foot rot of squash.
    d. Wilt diseases of tomatoes and eggplant.
31. Investigation of the X-disease of peach.
33. Diseases of ornamental plants.
    e. Rose diseases--powdery mildew, black spot.
    g. Chrysanthemum nematode.
34. Fungicides, new and old.
35. Apple spraying.
36. Antidoting phytotoxins and viruses by chemotherapy.

Control and Service

12. Seed testing. (In coöperation with the Commissioner of Agriculture.)
25. Spray service. (In coöperation with Extension Service, University of Conn.)

Soils

2. The physical and chemical characteristics of soils representing important types and cultural uses in relation to the nutritive responses of tobacco and other indicator crops in pot trials.
3. Nutrient requirements of vegetable crops on important soil types used for market gardening in Connecticut.
4. A study of soil conditions in relation to the growth and composition of natural mixed hardwoods and planted coniferous forests.
5. Lysimeter studies of the drainage losses and other changes that occur in soils under heavy fertilization as practised for tobacco and vegetables.
7. The improvement of the nutritional status of unproductive forest soils.
8. The agronomic application of rapid chemical tests for estimating the nutritional factors of soil fertility.
9. The evaluation of various soil factors in terms of land use and types of farming.
10. Nitrogen relationships in soil maintenance by green manures in vegetable cropping systems.

Tobacco Substation

1. Fertilizer experiments.
    bb. The relative efficiency of nitrogen from castor pomace, soybean oil meal and cottonseed meal.
    e. Comparison of various single sources of nitrogen. (Inactive)
    fa. Comparison of sources of phosphorus.
    qa. Fertilizer placement tests.
4. Tobacco nutrition studies.
    d. Symptoms of food element deficiency.
    h. Ammonification and nitrification of fertilizer materials. (Inactive)
    j. Absorption of magnesium from different carriers.
7aa. Improvement of Shade tobacco by selection and breeding. (In coöperation with the Conn. Leaf Dealers Assoc.)
9a. Brown root rot control in field plots.
13. Preservative treatment of shade tent poles. (See also Forestry, No. 12.)
15a. Topping experiments.
17b. The study of the cause of black Shade tobacco.
19. Investigation of various tobacco diseases.
    c. Pole rot.
    e. Breeding for mosoic resistant Broadleaf.
    f. Control of downy mildew.
    h. Breeding for resistance to downy mildew.

20. A study of insects that attack the tobacco plant. (In coöperation with the U. S. Dept. Agr.) (See also Entomology, No. 30.)
    a. Control of wireworms.
    b. Control of flea beetles.
    c. Control of thrips.
22. Irrigation of tobacco.
25. Spacing of Havana Seed tobacco. (Inactive)
26. Chlopicrin for sterilization of tobacco bed soil.
30. Chemical investigations. (In coöperation with the American Tobacco Co.)
31. Breeding for low nicotine content of leaf.

PUBLICATIONS

July, 1940 to July, 1941

BULLETINS OF THE STATION

The Improvement of Naturally Cross-Pollinated Plants by Selection in Self-Fertilized Lines. III. Investigations with Vegetatively Propagated Fruits. Donald F. Jones and W. Ralph Singleton. No. 435.

Commercial Feeding Stuffs. Report on Inspection, 1939. E. M. Bailey. No. 436.

Report on Food Products and Drugs for 1939. E. M. Bailey. No. 437.

Annual Report for the Year Ending October 31, 1939. No. 438.

Soil Management for Intensive Vegetable Production on Sandy Connecticut Valley Land. M. F. Morgan and H. G. M. Jacobson. No. 439.

The Biology of *Anasa tristis* DeGeer with Particular Reference to the Tachinid Parasite, *Trichopoda pennipes* Farb. Raimon L. Beard. No. 440.

Commercial Fertilizers. Report for 1940. E. M. Bailey. No. 441.

Chemical Investigations of the Tobacco Plant. VIII. The Effect Upon the Composition of the Tobacco Plant of the Form in Which Nitrogen is Supplied. H. B. Vickery, G. W. Pucher, A. J. Wakeman and C. S. Leavenworth. No. 442.

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All of which is respectfully submitted.

WILLIAM L. SLATE,
Director

REPORT OF THE TREASURER

W. L. Slate, Treasurer, in account with the **Connecticut Agricultural Experiment Station.**

July 1, 1940 to June 30, 1941

INCOME

STATE APPROPRIATIONS:	
Regular Funds	$247,100.00
Special:	
Dutch Elm Disease (Bal. of 1937 Appropriation)	4,166.02
Construction of Greenhouses	15,706.22
FEED FEES	16,950.00
FERTILIZER FEES	12,470.00
MISCELLANEOUS	415.64
TRUST FUNDS AND GRANTS	8,410.12
FEDERAL APPROPRIATIONS:	
Hatch	7,500.00
Adams	7,500.00
Purnell	30,000.00
Bankhead-Jones	10,329.04
	$360,547.04
UNEXPENDED FUNDS RETURNED TO STATE TREASURER at end of year	$ 13,611.98
NET INCOME	$346,935.06

July 1, 1940, to June 30, 1941

EXPENDITURES

	Personal Services	Contractural Services	Supplies and Materials	Capital Outlay	Total
STATE APPROPRIATION:					
Station General Fund	$ 76,002.11	$ 7,305.91	$ 7,294.93	$ 6,348.66	$ 96,951.61
Bee Diseases	1,218.00	890.36	.....	.....	2,108.36
Food and Drug Analyses	9,300.40	369.41	680.48	83.35	10,433.64
Gypsy Moth Suppression	41,919.16	868.22	2,201.49	2,189.75	47,178.62
Insect Pest Control and Research	45,210.03	1,841.04	1,645.28	2,063.05	50,759.40
Mosquito Elimination	9,785.61	1,464.36	156.79	3.50	11,410.26
Tobacco Substation	15,388.48	812.66	1,660.13	399.57	18,260.84
White Pine Blister Rust Control	3,335.98	885.28	95.60	.....	4,316.86
Special Dutch Elm Disease Fund	3,360.00	155.09	406.89	189.71	4,111.69
Construction of Greenhouses	.....	.....	.....	15,706.22	15,706.22
FEDERAL FUNDS	48,736.62	2,081.05	3,234.41	1,276.96	55,329.04
FEED INSPECTION	15,170.78	665.36	633.11	154.52	16,623.77
FERTILIZER INSPECTION	10,668.62	659.98	595.24	239.10	12,162.94
TRUST FUNDS AND GRANTS	5,363.21	18.75	1,313.87	877.01	7,572.84
	$285,459.00	$ 18,017.47	$ 19,918.22	$ 29,531.40	$352,926.09
Less Reimbursements	5,800.16	180.87	10.00	.....	5,991.03
Net Expenditures	$279,658.84	$ 17,836.60	$ 19,908.22	$ 29,531.40	$346,935.06